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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/823,298	04/12/2004	Liping Ren	IR-2390 (2-3	4746

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EXAMINER	
PIZARRO CRESPO, MARCOS D	

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 10/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/823,298	REN, LIPING	
	Examiner	Art Unit	
	Marcos D. Pizarro-Crespo	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 September 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9,11,13,14,16,20-23,25 and 27-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,11,13,14,16,20-23,25 and 27-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Attorney's Docket Number: IR-2390 (2-3965)
Filing Date: 4/12/2004
Claimed Priority Date: 4/11/2003 (Provisional 60/462,562)
Applicant(s): Ren
Examiner: Marcos D. Pizarro-Crespo

DETAILED ACTION

This Office action responds to the request for reconsideration filed on 9/28/2006.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after the final rejection mailed on 6/29/2006. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/28/2006 has been entered.

Acknowledgment

2. The request for reconsideration filed on 9/28/2006, responding to the Office action mailed on 6/29/2006, has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-9, 11, 13, 14, 16, 20-23, 25, and 27-29.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 25, 28, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujishima (US 6740952) in view of Rumennik (US 6639277).

5. Regarding claim 25, Fujishima shows (see, *e.g.*, figs. 15 and 19) most aspects of the instant invention including a field plate structure comprising:

- ✓ A first field plate **9**
- ✓ A second field plate **FP1** disposed above and spaced from the first field plate
- ✓ A third field plate **FP2** disposed above and spaced from the second field plate
- ✓ a resurf region **20** over which the field plate structure is disposed.

Wherein:

- ✓ the first plate **9** includes a first portion (see, *e.g.*, fig. 19)
- ✓ the second plate **FP1** includes (see, *e.g.*, fig. 19):
  - a first portion
  - a second portion
  - a second gap separating the portions
- ✓ the third plate **FP2** includes (see, *e.g.*, fig. 19):
  - a first portion
  - a second portion

- a third gap **Wg** separating the portions

✓ the second gap is wider than the third gap **Wg** (see, *e.g.*, fig. 19)

Fujishima, however, fails to show the first plate including a second portion spaced from the first portion of the first plate by a first gap wider than the second gap. Rumennik (see, *e.g.*, figs. 1 and 2), on the other hand, shows a first plate similar to Fujishima including a first portion **12** spaced from a second portion **26** by a gap wider than the gap separating portions **10,11** of a second plate above the first plate. He further teaches that the second portion **26** would function to increase the breakdown voltage of Fujishima (see, *e.g.*, Rumennik/col.4/ll.45).

It would have been obvious at the time of the invention to one of ordinary skill in the art to include the second portion suggested by Rumennik in the first plate of Fujishima to reduce the field concentration at the boundary between the drain region and the drift region.

6. Regarding claim 28, Fujishima shows (see, *e.g.*, fig. 19):

✓ The first portion of the second plate **FP1** is electrically connected to the first plate **9**

✓ The second portion of the second plate **FP1** is electrically connected to the second portion of the third plate **FP2**

7. Regarding claim 29, Fujishima shows (see, *e.g.*, fig. 19):

✓ The first plate is insulated from the second plate **FP1** by an insulation layer **10**

✓ The second plate **FP1** is insulated from the third plate **FP2** by another insulation layer **25**

8. Claims 1-9, 11, 13, and 20-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujishima in view of Rumennik, Van Zant and Ghandhi.

9. Regarding claim 1, Fujishima shows (see, *e.g.*, figs. 15 and 19) most aspects of the instant invention including a semiconductor device comprising:

- ✓ A semiconductor substrate **1** of a first conductivity type
- ✓ A semiconductor layer of a second conductivity type formed over the substrate **1**
- ✓ A body region **2** of the first conductivity formed in the semiconductor layer
- ✓ An invertible channel in the body region **2**
- ✓ A source region **3** of the second conductivity type formed in the body region **2** and adjacent to the channel
- ✓ A gate structure formed over the channel region including:
  - a gate electrode **9**
  - a gate insulation layer **7** spacing the gate electrode **9** from the channel
- ✓ A drain region **6** formed in the semiconductor layer
- ✓ A drift region **5** in the semiconductor layer spacing the body region **2** from the drain region **6**
- ✓ A resurf region **20** of the first conductivity formed in the semiconductor layer of the second conductivity type, said resurf region **20** being formed over at least a portion of the drift region **5**
- ✓ A field plate structure disposed over the drift region **5** including:
  - a first insulation layer **8** of a first thickness

- a second insulation layer **10** of a second thickness formed over the first insulation layer **8**
- a third insulation layer **25** of a third thickness
- a first plate **9** disposed over the first insulation layer **8**
- a second plate **FP1** disposed over the second insulation layer **8**
- a third plate **FP2** spaced from the second plate **FP1** by the third insulation layer **25**

Wherein:

- ✓ the first plate **9** includes a first portion (see, *e.g.*, fig. 19)
- ✓ the second plate **FP1** includes (see, *e.g.*, fig. 19):
  - a first portion
  - a second portion
  - a second gap separating the portions
- ✓ the third plate **FP2** includes (see, *e.g.*, fig. 19):
  - a first portion
  - a second portion
  - a third gap **Wg** separating the portions
- ✓ the second gap is wider than the third gap **Wg** (see, *e.g.*, fig. 19)

Fujishima, however, fails to show the first plate including a second portion spaced from the first portion of the first plate by a first gap wider than the second gap. Rumennik (see, *e.g.*, figs. 1 and 2), on the other hand, shows a first plate similar to Fujishima including a first portion **12** spaced from a second portion **26** by a gap wider

than the gap separating the portions **10,11** of a second plate above the first plate. He further teaches that the second portion **26** would function to increase the breakdown voltage of Fujishima (see, *e.g.,* Rumennik/col.4/ll.45).

It would have been obvious at the time of the invention to one of ordinary skill in the art to include the second portion suggested by Rumennik in the first plate of Fujishima to reduce the field concentration at the boundary between the drain region and the drift region.

Fujishima also fails to show the semiconductor layer is epitaxially formed. Rumennik shows that the semiconductor layer is epitaxially formed (see, *e.g.*, col.7/ll.21). Van Zant (see, *e.g.*, pp.382), on the other hand, teaches that epitaxially forming Fujishima's semiconductor layer would allow to accurately controlling the doping concentrations of the layer. Ghandhi (see, *e.g.*, pp.258) teaches that epitaxially forming Fujishima's semiconductor layer on the substrate would eliminate the problems of compatibility or mismatch between the layer and the substrate.

It would have been obvious at the time of the invention to one of ordinary skill in the art to epitaxially form Fujishima's semiconductor layer, as suggested by Van Zant and Ghandhi, to eliminate the problems of compatibility between the layer and the substrate and to accurately control the doping concentrations of the layer.

10. Regarding claims 2, 4, and 6, Fujishima shows the first **8**, second **10** and third **25** insulation layers comprising an oxide (see, *e.g.*, fig. 19)

11. Regarding claim 3, Fujishima shows the first thickness is 0.6 microns (see, *e.g.*, col.36/ll.20) but fails to specify the claimed thickness of 0.4 microns. However,

differences in thickness will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such thickness is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the workable ranges by routine experimentation". *In re Aller*, 220 F.2d 454,456,105 USPQ 233, 235 (CCPA 1955).

Fujishima also teaches that the first thickness, as well as the other thickness of the different insulation layers, affects the performance and the area of the device (see, *e.g.*, col.37/ll.15-29, col.8/ll.36-40, and col.39/ll.17-31). Therefore, it is necessary to ensure that the insulation layers are of an appropriate thickness (see, e.g., Fujishima/col.35/ll.60-62). The specific claimed first thickness, *i.e.*, 0.4 microns, absent any criticality, is only considered to be the "optimum" thickness disclosed by Fujishima that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired device performance, manufacturing costs, etc. (see Boesch, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, *i.e.*, results which are different in kind and not in degree from the results of the prior art, will be obtained as long as the first thickness provides for a stable performance of the device, as already suggested by Fujishima.

Since the applicant has not established the criticality (see next paragraph) of the claimed thickness of 0.4 microns, it would have been obvious to one of ordinary skill in the art to use these values in the device of Fujishima.

CRITICALITY

12. The specification contains no disclosure of either the critical nature of the claimed thickness or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim,

the applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

13. Regarding claim 5, Fujishima shows the second thickness is 1.3 microns (see, *e.g.*, col.39/ll.5).

14. Regarding claim 7, Fujishima shows the third thickness is 2.5 microns (see, *e.g.*, col.39/ll.7) instead of the claimed thickness of 1.4 microns. See also the comments stated above in paragraphs 11 and 12 with respect to the differences between the claimed thickness and that of the prior art, which are considered repeated here.

15. Regarding claim 8, Fujishima shows the first field plate **9** extending from the gate electrode (see, *e.g.*, fig. 19)

16. Regarding claim 9, Fujishima shows that the first field plate **9** comprises gate electrode material (see, *e.g.*, col.39/ll.9-10). Van Zant (see, *e.g.*, pp. 511), on the other hand, teaches that doped polysilicon is the standard gate electrode material for Fujishima's device.

17. Regarding claim 11, Fujishima shows that the gap between the portions of the second field plate **FP1** is 45 microns (see, *e.g.*, col.37/ll.29-34 and col.39/ll.13-16).

18. Regarding claim 13, Fujishima shows the third field plate **FP2** comprising a first portion and a second portion (see, *e.g.*, fig. 19), wherein a gap of 25 microns separates the portions (see, *e.g.*, col.37/ll.32).

19. Regarding claim 20, Fujishima shows the first portion of the first plate **9** terminating below the first portion of the second plate **FP1** (see, *e.g.*, fig. 19).

20. Regarding claim 21, Fujishima shows the second portion of the second field plate **FP1** is electrically connected to the drain region **6** and to the second portion of the third plate **FP2** (see, *e.g.*, fig. 19).

21. Regarding claim 22, Fujishima shows the first portion of the second plate **FP1** is electrically connected to the first plate **9** (see, *e.g.*, fig. 19).

22. Regarding claim 23, Fujishima shows the first portion of the third plate **FP2** is electrically connected to the source region **3** (see, *e.g.*, fig. 19).

23. Claims 14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujishima/Rumennik/Van Zant/Ghandhi in view of Noda (US 6617652) and Ranjan (US 5801431).

24. Regarding claim 14, Fujishima/Rumennik/Van Zant/Ghandhi shows most aspects of the instant invention (see, *e.g.*, paragraph 9 above). Fujishima also shows the second plate **FP1** including a first portion and a second portion, wherein a gap separates the portions (see, *e.g.*, fig. 19). He, however, fails to specify the portions to be annular portions disposed around the drain region **6**. Noda, on the other hand, teaches (see, *e.g.*, fig. 1) that annular plates formed concentrically around the drain diffusion region of Fujishima would improve the breakdown properties of the device (see, *e.g.*, Noda/col.14/ll.20-22). Ranjan elaborates by teaching that the series of plates in Noda reduce the tendency to concentrate high electric fields near the surface of the device thereby improving its breakdown voltage (see, *e.g.*, Ranjan/col.5/ll.52-56).

It would have been obvious at the time of the invention to one of ordinary skill in the art to form the first and second portions of the second plate of

Fujishima/Rumennik/Van Zant/Ghandhi as annular portions disposed around the drain region, as suggested by Noda and Ranjan, to improve the breakdown voltage properties of the device.

25. Regarding claim 16, Fujishima (see, *e.g.*, fig. 19) shows the third plate including a first portion and a second portion, wherein a gap separates the portions. He, however, fails to specify the portions to be annular portions disposed around the drain region. Noda, on the other hand, teaches (see, *e.g.*, fig. 1) that annular plates formed concentrically around the drain diffusion region of Fujishima would improve the breakdown properties of the device (see, *e.g.*, Noda/col.14/ll.20-22). Ranjan elaborates by teaching that the series of plates in Noda reduce the tendency to concentrate high electric fields near the surface of the device thereby improving its breakdown voltage (see, *e.g.*, col.5/ll.52-56).

It would have been obvious at the time of the invention to one of ordinary skill in the art to form the first and second portions of the third plate of Fujishima/Rumennik/Van Zant/Ghandhi as annular portions disposed around the drain region, as suggested by Noda and Ranjan, to improve the breakdown voltage properties of the device.

26. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujishima/Rumennik in view of Noda and Ranjan.

27. Regarding claim 27, Fujishima/Rumennik shows most aspects of the instant invention (see, *e.g.*, paragraph 5 above), except for the plate portions being annular. Noda, on the other hand, teaches (see, *e.g.*, fig. 1) that annular plates formed

concentrically around the drain diffusion region of Fujishima would improve the breakdown properties of the device (see, *e.g.*, Noda/col.14/ll.20-22). Ranjan elaborates by teaching that the plate portions in Noda reduce the tendency to concentrate high electric fields near the surface of the device thereby improving its breakdown voltage (see, *e.g.*, Ranjan/col.5/ll.52-56).

It would have been obvious at the time of the invention to one of ordinary skill in the art to form the plate portions of Fujishima/Rumennik as annular portions, as suggested by Noda and Ranjan, to improve the breakdown voltage properties of the device.

Response to Arguments

28. The applicant argues:

> No single embodiment cited by the examiner discloses the field plate structure recited in claim 25.

The examiner responds:

One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). In the instant case, Fujishima shows most aspects of the instant invention as set forth above in paragraph 5 of the present Office action. Fujishima, however, fails to show the first plate including a second portion spaced from the first portion of the first plate by a first gap wider than the second gap. Rumennik (see, *e.g.*, figs. 1 and 2), on the other hand, shows a first plate similar to Fujishima including a first portion **12** spaced from a second portion **26** by a gap wider than the gap separating portions **10,11**

of a second plate above the first plate. He further teaches that the second portion **26** would function to increase the breakdown voltage of Fujishima (see, *e.g.*, Rumennik/col.4/ll.45).

29. The applicant argues:

Rumennik discloses a structure significantly different from the embodiments of Fujishima. Rumennik discloses a source electrode **10** and a drain electrode **11** located near the top surface of the die. Fujishima by contrast discloses a source electrode **11** and a drain electrode layer **12** located in the middle of the embodiment of the die shown in figure 19. Thus, to arrive at the proposed combination to make the rejection, it is necessary for the examiner to seize upon arbitrarily selected features of Rumennik and then insert them into the middle of the die shown in Fujishima at a location selected by the examiner, and further, to change functions of the inserted embodiments. In addition, it would be necessary to seize the p-type top layer **20** of the third embodiment of Fujishima shown in figure 15, and insert this into the seventh embodiment of Fujishima shown in figure 19 just below the features taken from Rumennik.

The examiner responds:

In contrast to applicant's assertions, Rumennik discloses a structure significantly similar to the embodiments of Fujishima. Both show high-voltage lateral MISFETs having a polysilicon gate and a gate-insulating layer on a p-type substrate (see, *e.g.*, Rumennik: fig.2, and Fujishima: figs. 15 and 19). The gate, gate-insulating layer, and substrate form an insulated gate region in the devices of both Rumennik and Fujishima. Additionally, source and drain electrodes as well as a field plate structures are formed over the insulated gate regions of both devices.

On the other hand, the seventh embodiment of Fujishima (see, *e.g.*, fig. 19) has exactly all the features of the third embodiment of Fujishima (see, *e.g.*, fig. 15) but the p-type top layer **20**. In any event, Fujishima clearly teaches that there is an advantage to incorporating the p-type top layer **20** of the 3rd embodiment into the 7th embodiment in that, as well as being able to provide the n-type drift region **5** with a high concentration,

it is possible to maintain the withstand voltage, and a reduction in the ON resistance is also effected (see, *e.g.*, col.37/ll.50-60).

30. The applicant argues:

> The teachings cited by the examiner of reducing the field concentration at the boundary between the drain region and the drift region is too general to provide the motivation necessary for arriving at the proposed combination, involving features of two separate embodiments of Fujishima and additional features selected from Rumennik.

The examiner responds:

The teachings of Rumennik are clear and precise. Rumennik (see, *e.g.*, figs. 1 and 2) shows a first plate similar to Fujishima including a first portion **12** spaced from a second portion **26** by a gap wider than the gap separating portions **10,11** of a second plate above the first plate. He specifically teaches that the second portion **26** would function to increase the breakdown voltage of Fujishima (see, *e.g.*, Rumennik/col.4/ll.45).

31. The applicant argues:

> The problems recognized by the applicants and solved by the claimed invention, such as the issue of reducing high electric field gradients at the surface of a semiconductor die, are not disclosed or suggested by the cited references.

The fact that the applicant has recognized another advantage that would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious as set forth in paragraphs 4-27 above. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Conclusion

32. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

33. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(571) 272-1716** and between the hours of 9:00 AM to 7:30 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Marcos.Pizarro@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (571) 272-1705.

34. Any inquiry of a general nature or relating to the status of this application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the

automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

35. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 257/335-343,409,487,488,491-493,659	10/12/2006
Other Documentation:	
Electronic Database(s): EAST (USPAT, EPO, JPO)	10/12/2006

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MDP/mdp
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